

Threats to flora-based industries in Western Australia from plant disease

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Abstract

The flora of south-west Western Australia is known internationally for its rich array of species and its uniqueness. This floral wealth attracts many visitors, supports a thriving export trade in cut flowers, and contributes to one of the highest rates of honey production in the world. Many of these plants also have outstanding value or potential for amenity horticulture and floriculture. More recently, the importance of bioresources was highlighted by the discovery of a chemical, derived from a species of *Conospermum*, capable of inhibiting Human Immunodeficiency Virus (HIV). The Proteaceae are a key element of south-western Australian ecosystems, and are a key resource of all of these industries. *Banksia* and *Dryandra* are of particular importance for their attractive blooms, and are heavily exploited for their inflorescences, foliage and seed, and offer an important source of nectar. The destruction of large stands of these disease-susceptible species by a combination of aerial canker and *Phytophthora* diseases, clearing, fire, and other disturbances could cause a significant financial loss to all flora-based industries. Notably, these flora resources are used with little return to the State for their conservation and management. An attempt is made here to quantify the financial impost of such losses, and a case is made for the need to invest in the protection of these bioresources through appropriate management.

Introduction

The ecological impact of plant pathogens has been well documented (see Shearer 1994 and Wills & Keighery 1994), but the economic implications for flora-based industries are poorly understood. The destruction of large stands of susceptible species by various diseases, particularly where other disturbances such as clearing, fire and weed invasion act in concert, could cause a significant financial loss to all industries reliant on the native flora. This brief review highlights some of the potential threats of plant disease to various flora-based industries, and focusses in particular on the family Proteaceae, a key element of south-western Australian ecosystems, often a key resource of these industries, and highly susceptible to dieback disease and aerial canker.

Wildflower industry

The wildflower industry in Western Australia employs about 150 people full-time, and up to a total of 200 people during spring and summer (Anon. 1992). The principal product is dried flowers, but fresh-picked flowers, seed, and resource for craft-based cottage industry (using flowers, nuts, seeds, and dead woods) are also significant. Western Australia dominates the Australian export market, providing the majority of overseas sales (Castles 1993).

In 1992/93, the wildflower industry in Western Australia earned about \$17 million. Wildflower exports contributed most, earning about \$12 million (57% of all Australian wild

flower exports) with about \$4 million of this generated from bush-picked flowers. Currently 29% of bush-picked production comes from private land and 71% from Crown Land (Anon. 1994).

The Proteaceae are an important resource for the wildflower industry. In 1982, five of the 10 most heavily exploited genera were of the family Proteaceae (Burgman & Hopper 1982). Species of *Banksia* and *Dryandra* made up 17% of the stems picked, with two species (*B. baxteri* and *B. grandis*) the most heavily exploited for foliage; *Banksia* spp. were also heavily exploited for seed, making up 16% of all seed harvested by weight and 23% by value.

The impacts of plant diseases on the wildflower industry have been greatest in the south of Western Australia, east of Albany. In that area, commercial harvesting is based heavily on *B. coccinea* and *B. baxteri*. Both of these species have been severely affected by the root rot *Phytophthora cinnamomi* and more recently aerial canker.

From the mid or late 1970's, the *B. coccinea* harvest was concentrated on unvested reserves at Gull Rock and Cheyne Beach (25 and 80 km east of Albany respectively); picking of *B. baxteri* was centred on Cheyne Beach. In 1980-81, these species contributed 516,500 and 212,133 flowering stems respectively, to the total of 13,814,000 in Western Australia (Burgman & Hopper 1982) with the majority of these (at least two thirds) picked from Crown land. However, by the late 1980's these areas had been degraded to such an extent, that they were closed to pickers by CALM and other agencies. The creation of illegal vehicle tracks throughout these once dense stands appears to have contributed to the introduction and spread of *P. cinnamomi*. The disease has spread rapidly through sites killing many susceptible species including

Symposium on Plant Diseases in Ecosystems:
Threats and impacts in south-western Australia.
Held on April 16, 1994, at Murdoch University, by the Royal Society of
Western Australia and the Ecological Society of Australia.

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species of *Banksia*, and has resulted in major structural changes to the vegetation (see Wills & Keighery 1994).

As these areas were degraded, wildflower harvesting activities moved further east, concentrating on unvested reserves near Cape Riche. In assessing *B. coccinea* and *B. baxteri* across their natural ranges from around Albany and east to Esperance, Robinson (1991) found the remaining stands of both species were seriously threatened by aerial canker and *Phytophthora* dieback. The study highlighted that areas at Cape Riche, 100 km east of Albany, had numerous large *P. cinnamomi* infestations introduced as a result of the "bush bashing" of illegal tracks for wildflower picking. The study also noted that there had been a surge in picking activity on private land in the late 1980's as many farmers sought an alternative income by harvesting *B. baxteri* when returns from normal rural activities declined dramatically.

The combined impact of picking activities and plant disease depleting available stocks led to a ban on the picking of both species of *Banksia* from Crown land by the Minister for the Environment (*B. coccinea* in September 1991 and *B. baxteri* in March 1993), and has forced the supply of *B. coccinea* and *B. baxteri* from Crown land to private land. However, as many remnant stands of *Banksia* on private lands have also been destroyed by *Phytophthora* and aerial canker, there is now a strong move toward cultivation of both species.

The volume of trade in *B. baxteri* was 665,000 stems in 1991, largely through picking from private land (Robinson 1991). Similarly, 60% of 305,000 stems of *B. coccinea* produced in 1991 was derived from plantations (Robinson 1991). Notably, a recent study has suggested that remnant bush managed for sustainable harvest of wildflowers may, in particular areas, produce a return per hectare as good as that obtained by traditional forms of cropping (ACIL 1993).

In the long term, the cultivation of native flowers to supply the industry should ensure better quality (particularly through horticultural selection of preferred forms) and reliable supply. Although *Phytophthora* has been recorded within some cultivated stands around Albany for more than five years, its impact has not been as devastating as in natural bush. The disease can be controlled by application of the fungicide phosphonate ("phosphorous acid"; Shearer & Fairman 1991, Komorek *et al.* 1994, Hardy *et al.* 1994).

Aerial canker disease may prove to be a greater problem in plantations. Canker fungi may be spread by cross infection from secateur wound sites (J Bathgate, CALM, *pers comm*), and it has been shown that the frequency of infection was greater through wounded tissue (Bathgate *et al.* 1994), so it is possible that wildflower picking may accelerate the spread of aerial canker disease through *Banksia* stands. Fortunately, cross infection can be prevented or controlled by use of appropriate hygiene measures such as the application of fungicides on wounds and equipment.

Plant disease has also impacted on the native seed industry through the destruction of natural stands of *B. coccinea* by *P. cinnamomi*. Currently, stocks of seed of this species are very low and demands are not being met by traditional sources (P Luscombe, Nindethana Seeds, *pers comm*). South Australia is an alternative seed source, but the well established cut flower industry in that state is reluctant to supply

Western Australia. *B. coccinea* is now also being established commercially in south-eastern Victoria. Although the trend is toward cloning of superior forms, there will always be a demand for seed to explore the natural variation within the species.

Beekeeping

Reliance of apiculture on native floral resources is unique to Australia; in Western Australia the honey crop is gained almost entirely from native plant communities. Commercial apiarists in Western Australia practise migratory beekeeping utilising flowering of various *Eucalyptus* species in forests in the south-west of Western Australia in late spring, summer and autumn, and relocate to the sclerophyll shrublands of the Northern Sandplain for the winter flowering (Wills 1989). In contrast, beekeeping in the rest of the world generally relies on agricultural crops (mainly legumes) as their major source of pollen and nectar, and there is generally no winter production (Grout 1949, Nye 1980).

In 1992, Western Australia produced 2,264 tonnes of honey (Kelly 1993) worth about \$2.25 million. While Western Australia is the second smallest producer, producing only 14% of the Australian honey crop, rates of production are the highest in Australia and among the highest in the world (Wills 1989).

Honey bees tend to favour species which are either widespread and/or locally abundant, although some abundant species may not be visited (van der Moezel *et al.* 1987, Wills 1989). On the Northern Sandplain, Wills (1989) found that 93% of the total 125 species visited by honey bees were native woody perennials. The same study found that virtually all species of *Hakea*, *Grevillea*, and *Banksia* (Proteaceae) were utilised by honey bees. Two species of Proteaceae, in particular *Dryandra sessilis* and *Hakea trifurcata*, are considered by beekeepers to be the most important species in the region.

Given that *P. cinnamomi* is principally a pathogen of woody perennial plant species, that most species of Proteaceae are known to be susceptible to dieback disease, and that the Proteaceae are a significant resource for honey bees, then this plant disease poses a very serious threat to apicultural resources, especially in the Northern Sandplain area. Loss of native floral resources through land clearing has been identified as one of the most important threats to the continued economic development of the honey industry (Anon. 1983, Anon. 1984, Blyth 1987). Indeed, that part of the honey industry reliant on available native floral resources may have already reached an upper limit (Anon. 1984); any loss of native vegetation as a result of land clearing, fire, disease and other environmental perturbations will inevitably lead to a decline in apicultural production.

Biodiversity industries

The Convention on Biological Diversity (established in Rio de Janeiro at the Earth Summit, 1992) included a resolution to ensure access to genetic resources for environmentally sound uses while affirming national sovereignty. The Convention highlights the increasing global awareness of the importance of genetic resources in the production of valuable pharmaceutical, industrial and agricultural products.

South-western Australia is home to about 9000 species of plants, and as many as 2000 species may be susceptible to *Phytophthora* (Wills 1993). The Proteaceae are a key family in Western Australia with 618 species and subspecies, by far the greatest concentration in the world; many of these have outstanding value for amenity horticulture and floriculture (Lamont, Wills & Witkowski, *unpubl. obs.*), and most are susceptible to dieback disease.

One species of Proteaceae in the genus *Conospermum* is of particular significance in the area of therapeutic drugs. Extracts from this species have been found to contain chemicals that inhibit Human Immunodeficiency Virus (HIV) *in vitro*. In the spirit of the Biodiversity Treaty, the WA Government has negotiated an agreement with commercial interests which ensures proper protection of the plant and guarantees profits to the State if the chemical proves an effective treatment for HIV. The discovery has already earned the State \$1.7 million, and if successfully developed for market could potentially earn royalties in the order of \$100 million per annum (Armstrong & Hooper 1994, Armstrong & Abbott *pers. comm.*)

The Department of Conservation and Land Management is establishing bioprospecting based on four principles:

- the WA community receives an equitable share of commercial benefits derived from use of the State's biological resources;
- research and development of WA's biological resources should involve WA's scientific community;
- development of biological resources must be sustainable; and
- WA's biological resources must be protected and conserved.

Tourism

Tourists undoubtedly select destinations for a host of reasons, making it difficult to determine the actual contribution of floral resources to earnings in the tourist industry. The total 1989/90 income derived from tourism in Western Australia was \$2,785 million, estimated using the multiplier effect (Western Australian Tourist Commission 1991). In 1989/90 around 20% of tourist day-trip destinations involved a visit to a national park/reserve or a scenic drive (Western Australian Tourist Commission 1991). These activities involved some interaction with and appreciation of the natural features of the surrounding landscape and particularly the flora. Further, 11.5% of 33,246,700 visitor nights in 1991/92 resulted from trips to view wildflowers (Western Australian Tourist Commission 1992). This puts an upper range of the potential annual value of floral resources to the tourist industry of about \$280 million to \$560 million. The Western Australian Tourist Commission found that 116,000 group trips were specifically undertaken to view wildflowers, with visitor expenditure of about \$36 million (A Sands, *pers. comm.*). Consequently, any factor, such as plant disease, which degrades this natural floral resource might be expected to have a substantial negative impact on the economy of Western Australia. Or will it?

The Albany area receives about 250,000 tourists per year (Western Australian Tourist Commission 1992); the Stirling Range National Park, famous within Australia for its wildflowers, received 209,000 visitors (tourists and locals) in

1992/3. Notably, the next most popular visitor destination in the Albany area with 180,000 visitors was The Gap, a natural rock feature above the ocean.

A popular destination for visitors to the Stirling Range is Bluff Knoll, which received 36,000 visitors in 1992/3, yet the flora of Bluff Knoll has been severely affected by the spread of *Phytophthora* dieback disease from the lower slopes right up to the summit plateau. The jarrah woodland on the lower slopes has been severely diseased and species such as the Giant *Andersonia* (*A. axilliflora*), *Dryandra montana* and *Banksia oreophila* have been killed on the plateau. *Banksia brownii* which was once common is now absent from the summit and upper slopes. The dieback resistant sedge, *Lepidosperma* sp. has become far more common and dominant in large areas over the past ten years as dieback has altered the vegetation structure (G J Keighery, CALM, *pers. comm.*, Keighery *et al.* 1993, see also Wills 1993). However it is apparent that most tourists visit only once and do not appreciate the presence of dieback in the landscape. Most are still delighted by the flora and do not notice dieback disease which is so apparent to the trained eye.

The 1992 Spring period (September-December inclusive) accounted for 66% of visitors to the Stirling Range; up to 90% of the patrons to Stirling Range Caravan Park come from the Eastern States to see the flowers of the Stirling Range (G Souness, Stirling Range Caravan Park, *pers. comm.*). However, other high periods of visitation simply coincide with school holidays (Conservation and Land Management 1992) in January (11%) and April (13%). Clearly, the flora is not the only attraction to the Stirling Range, perhaps not even the main attraction. Even so, publicity in eastern Australia or overseas of the impact of dieback on the flora could potentially have adverse effects on flora-based tourist interests in Western Australia.

Downline Effects

Decline in activity of any of these flora-based industries will have flow on effects to other service industries that cater for all of the above. Because operations using native floral resources are necessarily regionally-based, they can be quite significant in the economy of small towns, and this may in turn contribute immeasurably to social values by supporting associated community infrastructures.

Conclusions

Clearly, the destruction of large stands of these dieback-susceptible plant species by a combination of disease, clearing, fire, and other disturbances could cause a significant financial loss to all flora-based industries. Protection of bioresources through appropriate management is not only in the interest of conservation, but carries with it financial benefits of the existing resource as well as retention of bioresources of yet unknown value.

The wildflower industry may eventually be able to obtain most of its requirements from plantation; beekeeping might also be able to link into the expansion of plantations for both the wildflower industry and also for agroforestry. But, wildflower-based tourism and biodiversity-based industries will necessarily rely on a relatively pristine bushland for

their continuation, and wildflower plantations will still require wild gene pools to maintain and extend varieties under cultivation.

Recommendations

Education of industry groups should be a part of licensing requirements for operation in wild populations of plants. All industries using natural bioresources tend to deny they are, or are ignorant of, contributing any significant ecological damage to the resource that sustains them. Managers and industry both agree that accurate statistical information provides a valuable resource for management; both groups must co-operate to ensure that information obtained as a part of licensing is both accurate and relevant, and that the results of its analysis are put in place.

Industry groups should be encouraged to contribute to and assist in the management process.

Acknowledgements: We thank S McEvoy (CALM Wildlife Branch) and A Sands (WATC) for access to unpublished data. We also thank K Atkins (CALM Wildlife Branch), H Allison, C Wills, G Friend and T Start (CALM Science & Information Division) and for their comments on earlier drafts of this paper.

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